

## **The environment of Caspian Sea: Consequences and Solutions**

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**Abstract:** The aim of this study is recognition of Caspian Sea natural features and pollutant resources. Basically, different sources take part in polluting of Caspian Sea which includes oil exploitation, entrance of industrial and household sewage and chemical fertilizers oil transit, oil tankers activities and fracture of oil pipelines at the bottom of the sea cause irreparable damage to Caspian sea like severe marine pollution and loss of many eco bio creatures. Generally, international actions should take place in the coastal countries and international organization to avoid irreparable consequences to this sea not like Aral Lake.

**Keywords:** Caspian Sea, pollution, household sewage, chemical fertilizers , oil pipelines

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### **INTRODUCTION**

Caspian Sea is the largest lake in the world which is in the Asia. This lake is called sea because it's the largest lake in the world. It consists of great resources of oil, gas and fish which caused many difficulties for this sea. Irregular exploitation of oil and gas it causes pollution irreparable damages to Caspian Sea. Also ecology of Caspian sea due to hyper exploitation from fish resources faces serious problems.

Other pollution can threat this sea including: industrial and agricultural sewage. This study is about recognition of pollutant resources of Caspian Sea and finding of regional and international solutions to deal with environmental pollution.

### **The natural qualities of Caspian Sea**

Caspian Sea is among four different groups of world seas and is the biggest closed world sea. Caspian sea with the length of 1160 km and average width of 330 km and an area of 422914 sqkm is larger even that the country of Japan. The total shore line of this sea amounts to 6400 km. The capacity of Caspian Sea water is equal to 78000 cubic meters. This sea, from the viewpoint of depth, ups and downs and some water qualities can be divided into three basins of northern, southern and central.

The water basin of this sea is about 3770000 sq km. Water entering into Caspian Sea has been estimated to be 260 to 340 sq km per year. Based on the extant statistics for a period of 94 years (1900-1993), around 81% of the water entering Caspian was from the

river Volga. The average depth of this lake in the northern part is 26 meters, in the central part 957 meters and in southern part is 960 meters. The salt level of Caspian Sea is 12/7 gr per liter. The Caspian Sea climate and its surrounding area, as a result of topography of the sea margins, are exclusive of this region. The average temperature in the months of July and august is between 24-26 degrees of centigrade and its minimum level is 10 degree centigrade. The average rainfall level over the sea is from 200 to 1700 mml. The evaporation level from the Caspian Sea surface is a lot and is about 1000mml throughout the year [1].

What is important environmentally in the Caspian Sea is the water flow model as one of the factors to transfer the pollutants. The reason for the circular water flow or the subsurface water flows to form is the entry of huge amount of sweet water from Volga River which along with climate factor and wind blow would cause the surface and subsurface water flows. The speed of water along the western shore is 25 to 5 m per second and along the eastern shores is 10 to 15 meter per second [2].

In the Caspian Sea, 727 animal species from 374 types live, 7% of this number is merely found in this body of water and not anywhere else. In this sea, about 100 species of fish, 1394 invertebrates, five type of organic plant and one sea mammal (fok) is identified [3].

### **Definition of pollution based on the world convention**

Today, the pollution of Caspian Sea in under discussion and importance of paying attention to its environmental consequences is part of the priorities of the eco-environment of human beings. One of the main issues in removing the marine pollutions is definitely lack of any definite definition of this concept. According to definition of united nation, pollution includes the direct or indirect entry of pollutant material by human beings into the sea environment which causes unpleasant consequences such as damaging the living reservoirs, risking human health, damaging the marine activities and reduction of the quality of water sea which would makes it hard to use [4].

Based on united nation's opinion, environmental pollutions can be divided into five major groups:

- Remvoing the sewage from house, industries and agricultural materials
- The intentional removal of the sewage from ships and other marine transportation means
- Disturbance of sea environment through discovery and extraction of oil and mineral material
- Removal of radioactive sewage produced from the peaceful usage of nuclear energy
- Military use of the sea [5].

Oil is one of the main reasons for the seas' pollutions. The entry of oil into the sea can be through the natural leakage of oil and gas and the rivers' flow or through human beings and shipping activities and the extraction. From all the resources of the oil pollution, the events from the oil ships or the explosions from the oil wells are among the most important ones which can cause a disaster in a short time [6].

In the absence of a given legal régime, the limit of responsibility of the littoral countries is not known considering the reservation of the sea environment. The economic needs and the mere attentions to making national income have caused protection of this sea environment to go out of sight. Some of the countries only think of more exploitation of resources which would cause harmful and irrevocable effects on the environment. The important point to notice is that at the time of making the agreements of 1921 and 1940 between Iran and former Soviet Union, the exploitation of the under bed resources of sea was not considered; the reason for that is the lack of adequate technology. That is why these agreements have not predicted any rules regarding this issue and only have made it enough to signify the rules of exploitation of the animate being of sea. Discovery of oil resources in the Azerbaijan's shores and beginning time to extract them in the years after Second World War and discovery of new reserves in the recent

years have made it a priority to determine the regime over exploitation of these resources. But the most important thing that Caspian Sea faces is the fact that littoral countries ignore pollution of the sea [7].

### **The critical environmental factors**

The environmental factor of Caspian Sea which is the biggest lake has a specific importance from the viewpoint of affecting climatic conditions of its neighboring regions and the world environmental cycle. On the other hand, the animate resources of this sea and the direct effect this body of water has for the residents of its neighboring countries is a vital one and any disturbance in the environmental balance of this sea has extensive consequences for the residents of the margins of this region and also for the world regarding unfavorable climatic changes. As a warning, the same environmental probable crisis of a Aral sea -which cannot be compared at all to Caspian Sea respecting the size and natural resources – and the measures taken for that crisis, has always had to be considered in the plans in order to open the Caspian Sea to the outside world [8].

The issues which threaten the continuation of life in the Caspian Sea are in the same line with other problems of other marine regions. What intensifies the environmental pollution of this environment is that this sea is not connected to other oceans and open seas. That is the reason why this sea does not have the self-purifying potential. This in its turn has brought about the sea not to have the comprehensive and consistent capacity in order to absorb and nullify the pollution caused by the human activities [9].

The increase of entry of the extra material into sea including biological, industrial and agricultural products and also the materials from mineral resources has continuously caused irrevocable damages to this sea. Following the collapse of former Soviet Union and the increase of the number of the littoral countries of this sea, there could be seen a kind of disorder in exploiting this sea while the responsibly of each country about the pollution of the environment of this sea is not clear [10].

Environmental issues of Caspian Sea are resulted from relentless exploitation of environmental resources, pollution from the oil and gas exploitations and the continuity of the pouring of industrial sewage into this sea. The estimations show that Russia would pour 50%, Azerbaijan Republic 16% and Iran 11% of the pollutant material into this sea respectively. Among the countries at the margin of Caspian Sea, Azerbaijan Republic as a result of the expansion of the oil industry in the sea and on land is the biggest polluting country of this sea. In fact, it can be said that this country uses this sea as the sewage well [11].

Based on the investigation done so far, the Caspian Sea faces three threats from environmental viewpoint:

- The fluctuations of the water surface (the rising of the sea level)
- Hunting the animate beings of the sea and too much fishing
- 3.The polluting foci on land
- Oil pollutions [12].

#### **The fluctuations of the water surface (the rising of the sea level)**

On the whole, the Caspian Sea has three types of the water surface fluctuations. First, the annual sinus fluctuations, second, the short term fluctuations with indefinite return period third, long term fluctuations.

#### **The reason for the occurrence of change on the surface of water**

- The temporary changes which are resulted from periodical changes
- Using the sea water for establishing dams
- Technonic moves of the sea bed
- Climatic changes as a result of changes in the rainfall
- The reduction of surface evaporations from oil pollution
- Increase of water from unconnected rivers to the sea
- Greenhouse effect and melting of polar ice
- Existence of hydrological connections between Black Sea, Aral Lake and Caspian Sea [13].

According to an article from Isoceta newspaper in 1994, Caspian Sea level at some points including Astrakhan has increased by 2.2 m. In this region ,740000 hectares of agricultural land has been flooded by water and 47 towns and villages are gone under water.3.7 million hectares of agricultural lands are about to be destroyed or become salty [14].

Rising of Caspian Sea in Azerbaijan shores till 1995 has brought 4 billion dollars of loss to this country. The environment commission for Caspian has declared that rising of Caspian Sea water level will flood some residential area and agricultural lands of cities of Lankaran and Astara. In 1996, the oil town of Dashlari in the shores of Azerbaijan Republic which was built on water went under sea. This town which was once considered as the pride of former Soviet Union technology is under the sea at the present moment. On the southeastern shore of Caspian Sea (Turkmenistan) too, the rising of sea level has brought many damages to the town and oil wells. Sea has begun to rise on the southwestern shore of Caspian Sea since 70 years and caused many losses [15].

#### **Hunting the animate beings of the sea and too much fishing**

While America, Russia and other countries of Caspian region have their conflicts for their ideological and economic influence, the fragile ecosystem of Caspian Sea has bent its back under burden of extraction of this sea's resources. The international trade convention of the endangered species has warned that too much fishing has endangered the survival of caviar.90% of the world caviar is extracted from Caspian Sea. Iran has always blamed the republics of former Soviet Union not for too much fishing but for oil digging while the importance of the environment of Caspian should not be underestimated [16].

#### **The polluting foci on land**

These pollutions are resulted from different sources such as urban development, agricultural development, industry, ports, and interfering into physical structure of shores which would cause the environmental changes.

On the whole, the main pollutants of Caspian Sea from land can be explained as the following:

1.Heavy metals 2.Oil hydrocarbon 3. Poisonous pesticides 4.The nutritious material 5.Micrboligic pollutants 6.The suspending materials on the water [17].

The most major pollutions from urban development at the shores of Caspian Sea include the pouring of unpurified house sewage into the sea and transferring oil materials from some economic units of cities. Doing agricultural activities almost throughout 2/3 of the year causes transferring of chemical material into the sea. Using chemical fertilizers and the poisons and pesticides are among the most important factors to pollute the sea from land. Setting up dams and physical obstacles over the rivers and taking water and sand from rivers are among other reasons to destroy the Caspian Sea environments.

#### **The oil pollution**

Pollution caused by the oil ships: at the present moment, the oil ships in the Caspian Sea have become more than 10000 in number per year and it is predicted that by increase of exploiting oil resources in the future years, this number would increase considerably. The solution of Iran in order to transfer oil from the region's countries using oil ship and through the method of "SOAP" and using that oil in the northern refineries of Iran and delivering the same amount of oil at the southern ports (Persian Gulf) would require having equipped ports far from sensitive environmental spots to avoid oil pollution in the Caspian sea while it increases the movement of oil ships in the southern part of Caspian Sea. The port facilities in the littoral countries of Caspian Sea are old oftentimes and do not have enough facilities to face the sea pollutions.

Anyways, loading and unloading of oil is along with disorder and with little negligence and unawareness, the harmful environmental threats would be resulted. The pollution of sea surface by the hydrocarboric material has caused death or decrease of reproduction among the sea plants and animals [18].

#### **Pollution through pipe line:**

Before laying pipes at the sea bed, having awareness of the physical and chemical climatic and environmental and geological conditions of the regions is necessary. The direct dangers resulted from establishing the pipeline in the extra border territories which is along with side effects such as digging the pathway, putting the pipeline at the sea bed and making the water muddy, is probable to destroy the animate life in the sea. The construction activities of laying pipe at the sea floor would disturb the sediments there. Re-distribution of such sediments would cause change in the present environmental conditions and also in the type of flora and fauna of the sea [19].

The activities related to laying pipes at the bottom of sea may disturb the fishing industry. Drawing the ship hook at the sea floor may damage the oil pipe and cause oil leakage. Rusting away of oil and gas pipelines at the sea bed and their destruction would cause oil and gas to leak into the water ecosystems. The harmful effects of these pollutants which are known as oil pollutions in the closed water environments is far more than what happens in the open seas and would damage the ecosystem in a greater way [20].

During the past 10 years, about 100 million tons of oil has been extracted from Caspian Sea bed. Unfortunately, one million tons of that is mixed with the sea water. Such oil pollutions are more seen in the western side of Caspian Sea and in Azerbaijan Republic and in the northern east and at Kazakhstan. Every year 35000 tons of oil material, only through Azerbaijan, is poured into Caspian Sea. [21]. In the middle of winter of year 1995, 1000 tons of raw oil was poured into Caspian Sea through leakage of one of the oil pipe lines in the Volga River. Following this incident, the local authorities of environment warned the residents of those areas not to fish from those parts. Only through Koura river in Azerbaijan, 75000 tons of oil material would enter into Caspian Sea per year and the researchers

announced that up to 70 km from the Bakou shore, there is not seen any trace of phytoplankton and all the sea bed of this region is polluted by oil. 200 tons of pitch, 10000 tons of tar, 75000 tons of oil and oil products, 2 million tons of sulphate and 58000 tons of nitrate would enter into Caspian sea and pollute it per year [22].

The researchers of Kazakhstan announced that some parts of Caspian Sea are polluted up to 11 times the tolerable level for the animate beings. The chief of environment organization of Russia announced that the animate beings reserves of Caspian have decreased at disaster levels in the recent years. Mohammadi por.n(2000). Despite that, the spoil production of littoral countries in the year 2001 and in the year 2006 has reached 1130000 barrels and 1700000 barrels respectively and it is predicted that the pollution level in the shores of Caspian Sea would reach four times the current level of it in the year 2020 [23].

#### **The pollution through accidents**

The accidents are one of the reasons why the oil exploitation from Caspian Sea is done in a critical situation, for an example, the fire in one of the oil wells of Caspian sea caused widespread pollution in the year 1971. Also, a big spot of oil in the southern part of Caspian Sea was seen in the year 1984 and during an accident, 47000 tons of raw oil from the oil field of Azerbaijan entered into this sea in the year 1987 [24].

The oil establishments in this region, especially Bakou, are very dangerous and out of international standards. The international law emphasizes that establishments in depth of less than 75 meters have to be closed [25].

Unfortunately, the extant rules about the excavation and development operation of oil regions in the sea are not adequate. The bigger problem is the inadequate supervision on the activities of the oil and gas producing countries in this sea. The necessary predictions about the authorized level of pollutants from the excavation and authorized distance from shore through which the pouring takes place do not exist in the rules of these countries even as much as Norway whose sea is not closed like Caspian [26].

**Table-1: The environmental consequence of dividing Caspian Sea [27].**

Resources	Percent
Disinfection supplies	70
Refineries. Petrochemical complex	7
Events	4
Offshore production	6
Other sources	13
total	100



Unfortunately, the government of USA and Turkey, while supporting the interests of their private companies, interfere into affairs of littoral countries and provoke international and regional conflicts which may cause many crises in this sea as a result of dividing Caspian into national parts. Based on the international statistics, the issue is that 7-9% of oil being extracted from plateau or the sea regions would pour into sea water as a result of different accidents. If all the oil resources which were discovered previously are exploited simultaneously, danger of sea pollution and destruction of its ecosystem would increase. It is enough to remember the fire in Tengiz field (north of Caspian Sea) which caused the northern parts of Caspian to be covered by the inflammable products. It is while that in the same place, all the caviar fish lay eggs.

It has to be stated that after collapse of Soviet Union and stopping the supervision over Caspian Sea, the caviar fish level reduced to one third of what it used to be. Based on the experts' estimation, the sale from it can have a bigger income than oil in case that fishing and regular farming of caviar fish are done. Destruction of caviar fish has caused destruction of all the layers of sea and shore ecosystems. If the intact regions of Caspian Sea which is the refuge of different types of birds are destroyed, there will be many problems for other various regions of the world where those birds live [28].

To preserve the unique nature of Caspian Sea, the shipping in this sea should be done according to plans. On the whole, all the economic activities in the Caspian region should account for the environmental security measures. But unfortunately, all the littoral countries of Caspian Sea only think of their economic and instantaneous considerations in their oil agreements of Caspian Sea and not of environmental issues [29].

#### **The international commitments of countries about preserving the environment of Caspian Sea**

The principle of governments' commitments to preserving environments has two dimensions of must and must not. The must part of it is that governments are committed not to cause damage to the environment. The must not part of it is about the governments' responsibility towards protecting environment. Observing this duty, besides being obligatory for the governments in their qualified territory, is necessary to be attended to and respected in the areas outside the national qualification of countries. The agreements about reserving the sea environments in the world and 1992 convention of biological diversity require the governments to adopt necessary initiatives to protect the biologic resources. Based on the article 21 of Stockholm statement and article 2 of Rio statement, the governments while having the rights over their natural resources and being free in exploiting them, are

committed not to do anything that may cause damages to the environment of other countries. This principle is accepted by all countries as the basic principle [30].

#### **The crisis of Aral Lake: an experience for the littoral countries of Caspian Sea**

Aral lake literally means an island. This lake is located in the sand deserts of central Asia. It is, by 1960's, the fourth largest lake in the world and the second largest one in Eurasian region. In the year 1953 when the situation of farming crops was bad in Russia, Khoroshkov stated the idea of farming the lands of Kazakhstan and western Siberia. Despite the crops being harvested from these lands, the weak and inefficient management destroyed a large part of crops from these lands. Water of lake reduced 40% on surface and 66% on level from 1960's till now as a result of changes in the irrigation system of the region and overconsumption of water from Amou and Sirdarya rivers in the irrigation canals for development of cotton production. The reduction of lake water caused change in its mineral combinations and intense increase of salt which in its turn brought about death of fish and different biological species. Gradual destruction of industries dependent on fishing is one result from this disaster. Lack of healthy and drinkable water and the ever increasing production of crops brought about the infliction of many of the residents with different diseases. It was so much so that 78% of residents living around Aral Lake were struck by different diseases and death of children in such regions.

In the environment preservation plan of UN (UNEP), drying of Aral Lake is one of the environmental disasters of 20th century. According to the estimation of World Bank; about 30 to 40 billion dollar is the cost of giving life back to Aral Lake in the 40 to 50 years to come. Naturally, the regional countries do not have enough resources to do it considering their available facilities. The present investigation show the fact that the chance of returning Aral to the conditions before this disaster does not seem possible. The only thing to be done is to stop the process of its water reduction and settling its present surface water and its total water level [31].

#### **The coordinated activities in order to stop the environmental pollution and improving it**

Today in the world, the oil eating microorganisms are used in order to reduce the oil pollutions in the seas. About Caspian Sea too, one of the major pollution sources is the existence of oil activities. Besides the business ships, frequency of the trucks carrying oil material has caused environmental damages to the Caspian Sea directly and indirectly and finally the rush of industrial sewages to this water basin would seriously affect environmental conditions [32].

Coordinated activities to face the potential and real dangers and in order to improve the environment are categorized into three groups:

- Activities of the littoral countries
- Activities of the international institutions
- Activities of the international organizations

#### **Activities of the littoral states**

All the littoral states of Caspian Sea have equal share about the issue of Caspian Sea pollutions regardless of taking part in the extraterritorial affairs or having suffered losses. Therefore, no country can hope to overcome this issue on its own. This necessitates cooperation in the region. In this regard, we can consider the following activities:

- Using the multipurpose research fleet to investigate and take care of plans based on regional and international needs
- Opening an information center to collect and categorize different data from the institutes and offices of littoral governments of caspian sea
- Developing the soft ware and hard ware for public information based on statistics data collected from caspian sea
- Establishing national and regional network to do satellite mapping
- Preparing the rules and regulations in order to develop a regional base for the littoral management as a tool for sustainable development of region
- Stopping any kind of exploiting the resources which are located in the regions about which there are different opinions [33].

#### **Activities of international institutes**

Caspian Sea is the house of the biggest population of world caviar fish. Concentration on the sea resources of this sea makes us understand a disaster which the health of environment faces as the environment is the fragile section of life anywhere in the world. The environment of Caspian in which pollutions has become reality of life is no exception. With more environmental awareness in the region, there would be more pressure in the direction of developing oil and gas which has to be done in a way that enough sensitivity is given to the environment. Basically, pollution is not something that can be fought without enough coordination of different sectors and countries. Coordination should be about controlling the resources which produce pollutions. One of such pollutant sources is the exploitation of resources on the bed and under bed of Caspian Sea. On the whole, the necessity of shared preservation of Caspian environment and its resources and its shared management is an issue which has been posed for long time for the littoral states of Caspian. Having awareness regarding this need has increased especially after the collapse of Soviet Union. One encouraging sign is to move towards more

cooperation in protection of Caspian Sea. Some activities have encouraged the regional cooperation in order to preserve the environment. Finally, the governments of the region, following a series of environmental agreements after collapse of Soviet Union, officially established the plan for Caspian environment in Ramsar meeting [34].

On the whole, the Caspian environment program considers environmental issues and the animate resources. It is categorized into different sectors which include:

- The effective regional management
- The regional base for management of data and information
- Regional evaluation of the pollutants level
- The sustainable management of fish and other animate beings resources of sea
- Consistent planning and management of the extra territorial littoral areas
- Fighting desertification of shore and drop of soil quality level
- Sustainable development and hygiene [35].

All of these sectors would necessitate the intense regional cooperation to fight the environmental pollution in the Caspian Sea. The goal of the Caspian environmental program is to manage the environment of this sea in the direction of the long term interest of the residents of the above mentioned area. Besides, the existence of this program and the sense of participation of international institutes such as the construction program of UN and the environment program of UN in this program are indicative of the importance of preservation of Caspian Sea environment from viewpoint of international community [36].

#### **Activities of the non-governmental organizations**

Before the year 1992, the agreements of 1921 and 1940 between Iran and former Soviet Union were dominant over Caspian Sea. When the former Soviet Union disintegrated, it was left to four remaining countries to rule over Caspian along with Iran. Today, the local activists are working in order to recognize and solve the environmental issues of their respective societies throughout this whole region. The non-government organizations trace and study different endangered species. They would also check the effect of laying pipes on the health of the animate beings in the sea. They develop the environmental educational program to educate children. They organize activities to inform people about the conditions of the region's environment. Any of the citizens' groups in each country has its own special challenges. But some shortcomings are shared throughout the whole Caspian region. A collection of reasons including the historically weak roots of the newly independent countries from former Soviet Union, the lack of activity from citizens,

the limited financial resources for non-governmental activities and the weak communication infrastructure have created a very difficult situation for all the non-government organizations. The traditional and trouble making forces have created extra obstacles for the non government organizations in the region which try to solve the environmental issues of Caspian with cooperation. In spite of all these obstacles, the non government organization continues on their work slowly [37].

#### Sum up and solutions (conclusion):

- The countries of region which all share in the natural and environmental interests of this sea have set out to comply the regional strategy in order to exploit its resources and reserves sustainably and consider the share of the future generations in this program.
- The reformation of national and regional laws in exploiting the animate and inanimate reserves of caspian sea is completely necessary and requires the participation and cooperation of the countries in the region.
- Supporting the organization of regional convention of preserving the caspian sea environment by the countries surrounding it in the short possible time.
- Avoiding one-product system in the agriculture and resorting to appropriate methods of planting seeds and irrigation and fighting the decadence of soil.
- Using the green fertilizer to strengthen soil instead of chemicals.
- Doing the operation of primary purifications or the installation of the local and house biogas units in purifying the urban sewage .
- Observing the security issues in transporting the oil cargoes, using the appropriate methods of discovery and extraction of oil from sea and carrying it to the shore.
- Creating the facility to receive the extra oil material in the ports and terminal and complying the regional regulation in order to transport and empty the oil with regards to the capacity of oil ships.
- Making the necessary insurance coverage for the floaters and the sea activities in order to make up for the environmental damages.
- Identification and signification of the sensitive littoral regions in the caspian sea and preserving the biodiversity on the shore and in the sea by creating the preserved areas.

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